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# Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Lubrication of Pneumatic Machinery

PUBLISHED MONTHLY BY
THE TEXAS COMPANY, U.S.A.
TEXACO PETROLEUM PRODUCTS

**Failure** of a riveting hammer in bridge construction, a rock drill in a mine, or an air hoist might easily involve not only serious time losses and repair costs, but also personal hazards. And failures are very frequently due to careless or imperfect lubrication.

# The Element of Protection

The rugged construction of the average pneumatic tool, rock drill, etc., frequently fosters an attitude of neglect on the part of those who are not familiar with the intricate mechanisms within. In consequence, such equipment is far too often subjected to careless handling, dirt, dust, water and mud.

Of course this does not improve operation. But if properly lubricated with carefully selected oils and greases, working parts will be protected to a considerable extent.

Pneumatic Machinery requires the most careful lubrication, for by virtue of its service, Pneumatic Machinery must function continuously and effectively.

So it is that *Lubrication*, a minor detail in the cost of operation, is a vital factor in reducing cost of upkeep and maintenance.

To meet these conditions The Texas Company, by using carefully selected stocks, is able to produce oils and greases which are unusually well adapted to the requirements of Pneumatic Machinery.

The chart shown on the inside back cover is indicative of this; we recommend it to your careful study.

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# LUBRICATION

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# Lubrication of Pneumatic Machinery

IN THE development of means and methods of industrial production the use of compressed air has been an outstanding feature. In fact, air may well be regarded as the essential factor in bulk production, be it in the coal mine, the stone quarry, the shipyard or atop of the modern skyscraper. Without the rock drill, rivet gun, etc., for example, we would indeed be in a sorry plight.

Next to electricity, compressed air is to the layman perhaps the most familiar medium whereby energy is transformed and work performed. The rat-tat-tat of the riveter's gun is almost as common as the whirring of our office electric fan; and on every side we see the concrete breaker and rock drill doing the work of a gang of laborers and in far less time.

Elsewhere in industry we find a wide variety of air tools used, such as

Rock Drills (which include)
  Stopers,
  Augers,
  Drifters,
  Hand Hammers.
Riveters,
Rotary Drills,
Pile Hammers,
Stone Carving Tools,
Wood Boring Machines,
Rotary Reaming and Tapping Equipment,
Chipping and Caulking Hammers,
Paint Sprays,
Hand Grinding Devices,
Etc., etc.

In turn, air is also extensively employed for the hoisting of materials, or the operation of elevating equipment, such as air hoists, of either the geared or direct lift type.

In the March, 1924, issue of LUBRICATION the air compressor was discussed in detail, especial emphasis being laid upon the air cylinders inasmuch as these present, as a rule, the more frequent problems in their lubrication. It is, therefore, fitting to now discuss the lubrication of air tools, or the pneumatic machinery whereby compressed air is utilized in construction, demolition and the production of materials for our daily use.

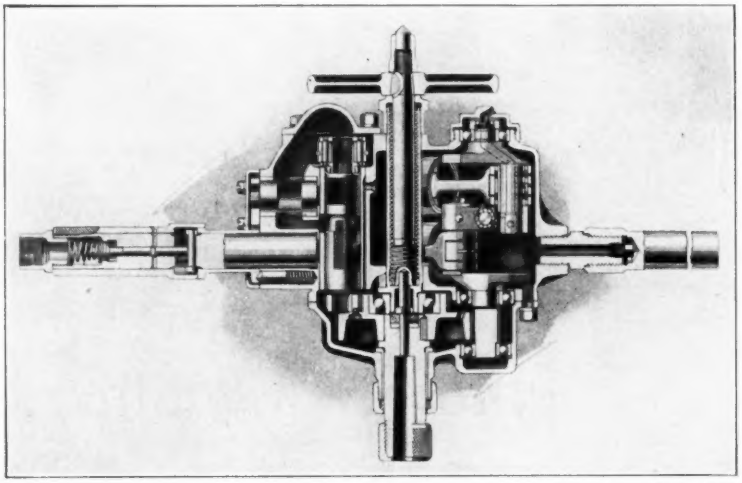
## IMPORTANCE OF LUBRICATION

Pneumatic tool lubrication may likewise involve frequent problems. In order to obtain the maximum of efficiency from such equipment and eliminate the necessity for repairs, it is absolutely essential that they be handled intelligently, kept as clean as possible and lubricated thoroughly and frequently with lubricants suited to the operating requirements.

In many cases automatic lubrication is provided for, rendering continuous operation practicable for an indefinite length of time. In others, however, this is not possible and the tools must cease working for the few minutes necessary for lubrication. When we figure the value involved, and the benefits to be derived, such as greater efficiency and reduction in cost of maintenance, we are justified in regarding such delays as practically immaterial and certainly quite warranted.

At best a pneumatic tool will be subjected to rough handling, dust, dirt, frequently water conditions, and operation under temperatures of marked variation.

From the rivet gun in a case of boiler repair, to a rock drill operating outdoors in weather below zero, is a wide range. In neither case can lubrication be faulty for both will involve material losses if tool failures occur. Therefore, this matter of pneumatic tool lubrication, from the viewpoint of design, construction, operating conditions and lubricating requirements demands the most careful attention.



*Courtesy of Ingersoll-Rand Co.*

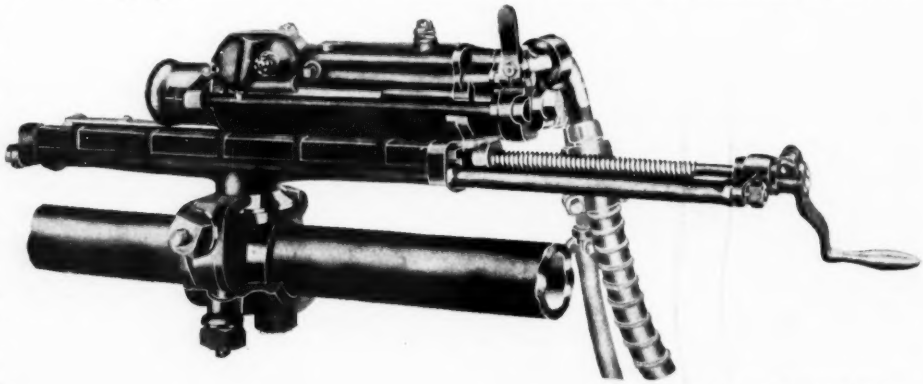
Fig. 1—Sectional view of a reversible air drill showing details of construction. A suitable case vent through the crank pin and crank to atmosphere vents the case, eliminates grease blow, and cools the crank pin. Grease is thrown into crank pin bearings by centrifugal force.

## PURPOSE

As the name implies, a pneumatic tool is a mechanical device usually portable in nature, self contained in regard to its propelling and operating mechanisms, functioning by the energy resulting from the expansion of compressed air. The basic purpose of a pneumatic tool is to supplant the tedious and more or less unsatisfactory methods of manual labor with the far more rapid and efficient methods of automatic production. The wide adaptability of compressed air in this regard can be noted from the list of tools mentioned at the beginning of this article.

These desired results are attained either by the effects of percussion or rapid hammering at the rate of often several thousand strokes per minute, or constant pressure, or, in some cases, a combination of pressure and rotation. Where percussion is employed, as in the case of certain types of rivet, caulking and chipping hammers, etc., air pressure acts on the tool mechanism in much the same manner as steam acts on the pistons of a steam engine. In other words, the tool mechanism involves one or more cylinders with suitable companion pistons, and either an arrangement of valves for the admission of air at the proper time, according to the number of strokes per minute or percussive frequency required; or, as in the valveless type, a piston which acts as its own valve.

Just as in the reciprocating steam or internal combustion engine, where valves are required, there will usually be two sets involved: i. e. (a) Those which, by virtue of their timing, control the frequency with which the air pressure is allowed to react on the piston; and (b) The throttle valve whereby the operator is able to control the amount of air admitted to the tool.



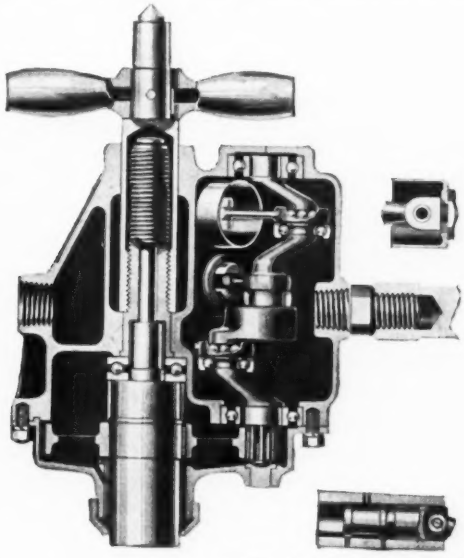
*Courtesy of The Denver Rock Drill Mfg. Co.*

Fig. 2—A drifting drill as used extensively in the mining industry. This drill can be operated either wet or dry, i. e., with or without water depending on the service and cutting involved. In either case careful lubrication of cylinders, rotating elements and chucks is of course essential.

We are, therefore, confronted with more or less the same conditions of wear as in the reciprocating engine. In the matter of lubrication, however, and the reduction of this potential metallic wear between cylinder walls and pis-

tons, etc., an opposite consideration is involved. Instead of relatively high temperatures as in a heat engine, we will have low temperatures to deal with. Steam gives off heat; petroleum fuels in their combustion develop heat; air, however, in its expansion and passage through pneumatic tools, unless preheated, absorbs heat from its surroundings.

In consequence, unless atmospheric temperatures are relatively high, this expansion temperature may run quite low. So pneumatic tool lubricants must be able to withstand low temperatures as a general rule.

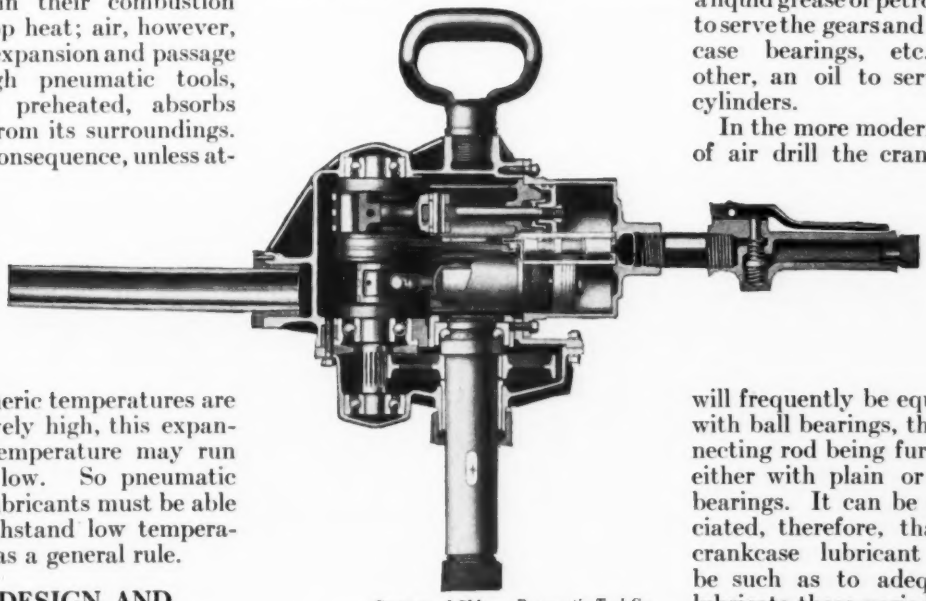


*Courtesy of The Clereland Pneumatic Tool Co.*

Fig. 3—Interior view of an air motor. Crank and crank bearings, ball bearing connecting rods, pistons, gears and pinions, etc., can be effectively lubricated by grease injected into the case by a suitable gun.

## DESIGN AND CONSTRUCTION

In order to lead to a better understanding of the necessity for careful and proper lubrication, attention is called to the many illustrations accompanying this article.



*Courtesy of Chicago Pneumatic Tool Co.*

Fig. 4—Sectional view of a portable air drill showing cylinder arrangement, reciprocating mechanisms, and gear connections. Note the use of ball bearings on crank shafting. Working elements are splash lubricated.

It will also be of decided interest to discuss some of the more extensively used types of tools from the viewpoint of their principles of operation and details of construction.

### Drills

Among the rotary type of pneumatic tools the drill is, perhaps, the foremost in usage and importance. Adaptable to wood, metal and stone working, according to the nature of its cutting tool, it is a very valuable piece of equipment in industry.

As generally constructed, a rotary air drill will comprise a number of suitable cylinders with their respective pistons; the requisite crankshaft and connections for transformation of reciprocating motion into rotary motion; a train of gears for bringing about speed changes and the requisite gear and crankcase. Many of such drills are of the balanced piston type with four single-acting pistons, opposed or connected in pairs to opposite wristpins of a double crankshaft.

*Lubrication*

In drills involving gearing the matter of lubrication requires that gears, crankshaft bearings and cylinders must be served. As a rule this can be adequately taken care of by means of two lubricants: one, of the nature of a liquid grease or petrolatum to serve the gears and crankcase bearings, etc., the other, an oil to serve the cylinders.

In the more modern type of air drill the crankshaft will frequently be equipped with ball bearings, the connecting rod being furnished either with plain or roller bearings. It can be appreciated, therefore, that the crankcase lubricant must be such as to adequately lubricate these varied bearings, with the least amount of internal friction and tendency to separate or to develop free fatty acids. In consequence, greases for this purpose should be selected with the utmost care.

In both crank and gear cases, by virtue of their dust proof construction, there is but little possibility of dirt or dust entering to

*Courtesy of Hanna Engineering Works*

Fig. 5—A yoke riveter designed for heavy duty. The capabilities of this tool can be realized by noting its 36" reach, 21" gap, and 70-ton pressure.

contaminate the lubricants. They should, therefore, function effectively for indefinite periods with but little renewal. In operation the heaviest duty is imposed by reason of the churning action which such lubricants are subject to.

Air cylinder lubrication involves the same problem of possible low temperatures as already stated for other such equipment. In rock drills, especially, will there be possibility of abnormally low temperatures, due not only to the moisture, which is usually in the air, but also the fact that narrow, tortuous air passages must generally be traversed in the course of expansion. In such drills it is frequently customary to "lubricate the air" prior to its delivery to the tool, a suitable lubricating device being installed in the air line a short distance back from the throttle valve.

## Riveters

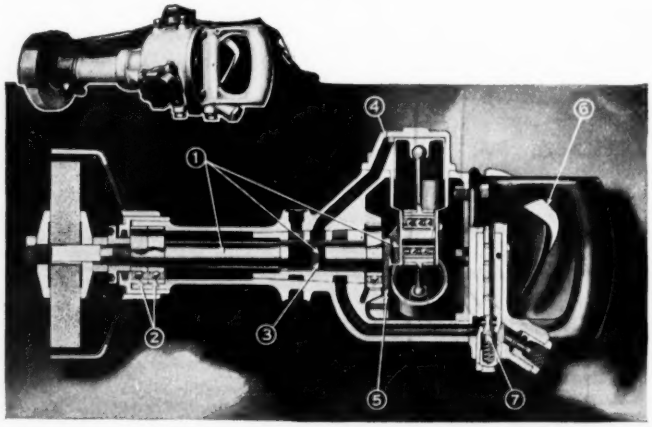
Riveting tools are essentially of two types, dependent upon whether they perform their function by percussion or the striking of blows in forming the rivethead, or by pressure in a similar manner to the forging press. It is of interest to note that the former involves an application of the principle of swaging, the metal being caused to literally flow into the proper shape of the rivet head under the effect of the rapid percussion of the tool. Where constant pressure alone is involved, in certain tools, rolling action is also employed, especially for small rivets, by the action of a set of rollers functioning under pressure.

## Pneumatic Hammers

In the case of hammers, however, percussion or the rapid striking of blows is the essential action involved. The self-contained forge hammer is an interesting example wherein the air-operated ram is alternately raised by the dual means of compressed air pressure below, plus a partial vacuum above, and forced down by a reversal of these means of operation.

## Pneumatic Hoists

The power hoist which employs compressed air as the operating media is another interesting machine pertinent to this discussion. As noted, pneumatic hoists may be either of the direct lift or geared type dependent upon whether air pressure acts directly upon the piston, or operates an air motor, which, in turn, drives a hoisting drum by means of worm or spur reduction gears.




*Courtesy of Ingersoll-Rand Co.*

Fig. 6—Details of a pneumatic grinder showing cylinder, crank pin and spindle details. This tool can be effectively lubricated by grease.

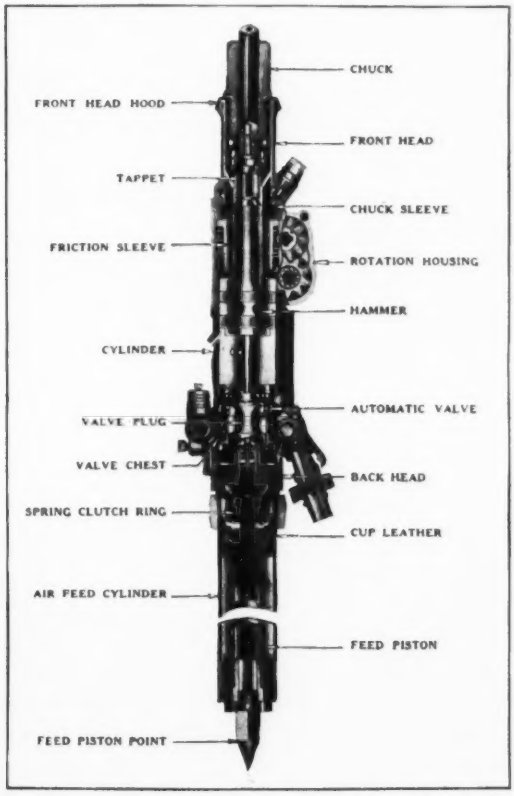
Pneumatic hoists are chiefly used for short lifts in such localities as machine shops, forges, foundries, etc., where compressed air is avail-

able. The direct acting hoist may be either single or double acting, according to the construction and provision for air inlet. The single acting hoist is essentially a vertically operating device, air being admitted below the piston to raise it, as desired.

The double acting hoist, on the other hand, may be used in either horizontal or vertical position. In this type of hoist the power end of the cylinder is under a constant pressure of air; the opposite or balancing end is likewise under pressure, but this latter is capable of variation, according to the load carried or duty required. In this case pressure can be varied from no load to full or balanced load.

## OPERATING CONDITIONS

Perhaps as forcible a way as any to drive home the importance of proper lubrication of




*Courtesy of The Denver Rock Drill Mfg. Co.*

Fig. 7—Sectional view of a turbro stoper. This tool is provided with two lubricators, one located on the valve chest to serve the valves, hammer and turbine gears; the other on the chuck end to lubricate the moving elements of this mechanism.

pneumatic tools in general is to call attention to certain of the illustrations which accompany this article. The fact that such equipment is as a rule extremely rugged in appearance often leads to a false impression in regard to the intricate mechanisms within. So drills, riveting hammers, and what not, are continually subjected to unnecessarily hard service on jobs, being thrown around or dropped regardless of whether they land in mud, slush, rock or even water.

*Courtesy of Chicago Pneumatic Tool Co.*

Fig. 8—A tripod mounted sinker drill, showing the tool and its accessories when ready for service.

Handling in this manner will be found to result in more or less ultimate damage to the working mechanisms, even if the casing is rugged enough to come through whole. Furthermore, a certain amount of dust, dirt and water will find their way in to damage, score or abraid the wearing elements when coming in contact therewith.

### Water

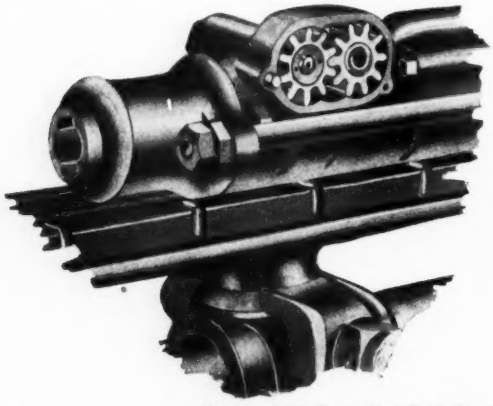
It is relatively difficult for any lubricant to withstand such conditions however suited it may be to the actual operating requirements. Water for example will tend to wash off the lubricating film from wearing surfaces. It is for this reason that compounded lubricants, i. e., mineral oils containing more or less animal oil or soap in compound are recommended for the lubrication of such equipment as hammer drills where operating with water. Such lubricants

function on the same principle as do steam cylinder oils. In other words they emulsify with water, by virtue of their fatty content, creating an adhesive emulsion which adequately resists the washing effects of water and sticks tenaciously to all wearing elements.

*Courtesy of Ingersoll-Rand Co.*

Fig. 9—An air drill in action. Note particularly the oiler located in the air line (in the foreground) for the purpose of automatically injecting the requisite amount of oil into the air in its passage to the tool.

But such lubricants are only recommended for air tools wherein water is intentionally mixed with the air to serve the purpose of washing cuttings from the hole, in much the same



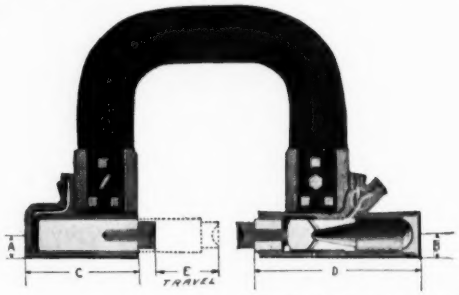
*Courtesy of The Denver Rock Drill Mfg. Co.*

Fig. 10—Details of the air turbine of a turbro drifter. The rotors are mounted on roller bearings.

manner as a soluble oil solution washes metal cuttings away from the tool in the machine shop drill, etc. Where pneumatic tools are designed to function dry, they should be absolutely dry—that is, free from moisture as far as possible. For on such equipment straight mineral lubricants are generally used. These, if properly refined and of the requisite viscosity and pour test, will adequately withstand any washing effect that may occur from condensation of moisture from compressed air as normally used. They will not, however, protect the wearing surfaces against an excess of moisture as may occur if the tool is dropped in the mud or allowed to remain exposed to the elements for any length of time while not in use.

The ultimate result will, of course, be rusting and corrosion, with subsequent difficulty in operation, an inability to perform its rated amount of work, and the necessity for repair or replacement of parts.

In the wet type of tools such as hammer drills, water leakage must also be guarded against. As a result, conditions in the cylinders are somewhat similar to those encountered in the cylinders of pumps. In the case of mine drills this water may also frequently contain an appreciable percentage of acid, leading to the added possibility of corrosion.




*Courtesy of Canton Pneumatic Co.*

Fig. 11—Sectional view of a bench and pedestal riveter. This is of valveless construction, with relatively few parts to cause trouble or meet with lubricating difficulties.

## Dust and Dirt, Etc.

Dust and dirt which may gain entry in much the same manner, through careless handling, not to speak of the dirt which may be carried through the tool by the air itself, will in turn be detrimental and cause abnormal wear as stated.

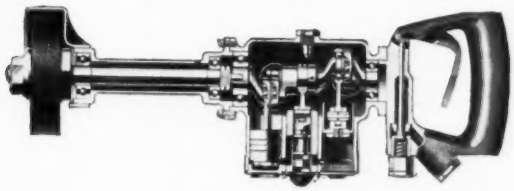
It is relatively easier to protect a tool from the entry of abrasive foreign matter via the tool itself than via the airline. Rarely will any appreciable amount of dirt penetrate the tip orifice while air is passing through it. All that is usually necessary is, therefore, care in handling when not in actual operation. So if when inactive, it is stored or rested in a position or locality free from dirt, it should function satisfactorily, all other things being equal, for an indefinite period.

Clean air, however, is not always possible to obtain. This will all depend upon the location of the compressor, its air intakes, whether or not air filters are installed, and the cleanliness of the air coolers and air lines.

Furthermore, there will also be the possibility of particles of rust being carried along by the air, especially where lubrication has not been adequate in the protection of those parts of the system exposed to moisture. Then too, particles of rubber from the air hose and gaskets may also find their way into the air passages and cylinders along with other foreign matter, to materially interfere with the free operation of the tool.

A wire strainer of suitable fineness located in the inlet pipe will be found to be advantageous in the removing of much of the above foreign matter and the protection of the working mechanisms of the tool.

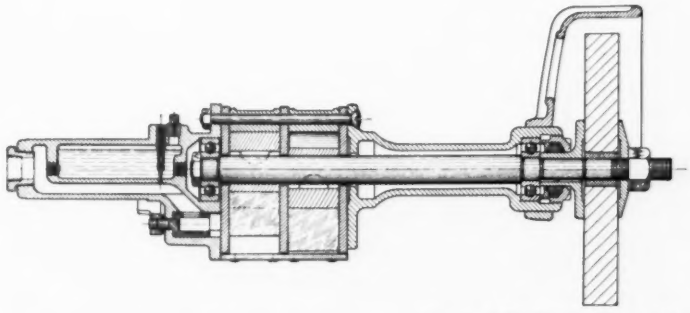
To further protect pneumatic tools against the entry of foreign matter, care must also be exercised in regard to the feeding of the lubricants. Where automatic lubrication is provided for by means of pipe line lubricators or atomizers which mechanically deliver the requisite amount of oil to the air lines, there will be the least possible chance of dust or dirt being carried in, provided that the oil is properly stored and handled. Such devices literally lubricate the air, as already mentioned, in much the same manner as mechanical or hydrostatic lubricators will lubricate the steam in a steam engine. Air under pressure just like steam will readily carry properly atomized oil to the working elements of the tool, adequately distributing it to all wearing parts.



*Courtesy of The Cleveland Pneumatic Tool Co.*

Fig. 12—Cross-sectional view of a grinder as used for light and medium service. A feature is the ball bearing motor.

Where drills, hammers and other such tools must be periodically oiled by hand, however, in the absence of automatic means of lubrication, there may be more possibility of accidental entry of dust or dirt occurring. At best, operators' hands will be dirty, and in such localities as mines, quarries, etc., the atmosphere will often be laden with dust. Of course under such conditions the lubricants for current usage should be stored and handled with the utmost care. Cases have been seen where these latter were kept in open cans adjacent to the tools, the only apparent idea being handiness and to eliminate loss of time as far as possible when lubricating. Naturally considerable dust and dirt was bound to settle in these containers with the result that the tools were practically being lubricated with an abrasive compound.



*Courtesy of The Warner & Swasey Co.*

Fig. 13—View of a grinder which operates on the rotary principle. There are but three moving parts involved. There is an oil reservoir in the handle with sufficient capacity for one shift of continuous operation. A medium viscosity oil is best suited to the requirements of this tool.

## LUBRICATING REQUIREMENTS

With a casual understanding of the principles of air tool design and construction, and a knowledge of those operating conditions which may affect proper functioning of lubricants, the question of the requirements which these latter must meet will be of decided interest.

Broadly speaking, pneumatic tools require three distinct varieties of lubricants. In this connection mention has been made of the necessity for using compounded lubricants on tools wherein water is employed; also there are those cases where low pour test is essential; and finally we have those heavy slow moving tools or parts which will function best on grease.

*Courtesy of The Denver Rock Drill Mfg. Co.*

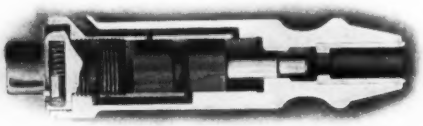
Fig. 14—The worm reduction gear arrangement as employed on certain types of rock drills. Parts of this nature of course require careful attention to lubrication, if they are to function with maximum efficiency.

Oils are in general required for valve and cylinder lubrication of higher speed tools, and

in some cases for the lubrication of the chuck parts and impact end of the piston.

## Pour Test

The fact that the pour test is essentially the most important characteristic of any oil which is to be used for pneumatic tool lubrication, renders a brief description advisable due to the confusion that may frequently arise in this regard, and the methods of test which are employed. Take the so-called "cold test" for



*Courtesy of The Dallett Co.*

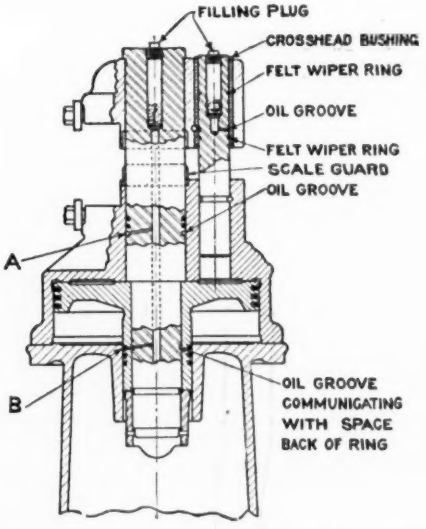
Fig. 15—Section of a carving tool as used in the stone-working industry. This is a valveless tool requiring a light mineral oil for its lubrication

example. This has been regarded variously as that temperature at which an oil loses its fluidity, or the temperature at which solid matter commences to separate. The fact that this latter pertains directly to paraffine base oils, renders this term more or less irrelevant in respect to naphthenic or mixed base lubricants. Yet it is these latter which are most directly applicable to pneumatic tool lubrication.

In the case of paraffine base oils the "cold test" or "cloud test" as it is more generally known today, is that temperature at which solid paraffine wax commences to crystallize out or separate from solution when the oil is chilled under the conditions specified for the method of test. Were we to apply this test to a naphthenic base oil we would be dealing with that temperature at which fluidity practically ceases. This temperature has with equal vagueness been variously termed the "melting point," "setting point" and "point of congealment." Today, however, it is more generally known as the "pour test" where any other than paraffine base oils are being dealt with.

There has also been marked confusion in regard to methods of determining this temperature and ignorance in regard to the factors which may have influence upon accurate determination. Especially is this true in regard to the preparation of the sample for test. The effect of cold upon lubricating oils is not the same as upon simple fluids such as water, alcohol, glycerine, benzine, etc. The latter have fixed and accurately ascertainable freezing points at which a complete change from the liquid to the solid state takes place, but lubricating oils which are mixtures of hydro-carbons of various melting points or freezing points behave like solutions, and frequently deposit some portion of their constituents before the whole mixture solidifies. Interesting phenomena which can only be explained by changes in the inner or molecular structures, are observed in the pour test of many lubricating oils. If, for example, we take the pour test of an oil without previous heating and then take the pour test of the same oil after heating to 120 degrees Fahr., after allowing it to cool to the same temperature as the first, the oil which is heated solidifies at a significantly higher temperature and the influence from preheating seems to be effective for a considerable time at least for 24 hours. Heating to temperatures below 90 degrees Fahr. apparently has no influence.

Another factor which has an effect on the test is stirring the oil while cooling to determine the pour test. In case an oil is stirred it solidifies at a lower temperature than when held stationary. This may be explained on the assumption that the movement of the oil destroys the formation of a fine network of microscopic




*Courtesy of Ingersoll-Rand Co.*

Fig. 16—The oiling system of a drill sharpener.

particles of paraffine or asphaltic bodies which are separating out. This segregation gives the oil a certain support and thereby facilitates solidification. In an analogous way this explanation may apply to the influence of preheating; the waxy or asphaltic particles are probably transformed by warming, into a very strongly dispersed state from which it is pos-

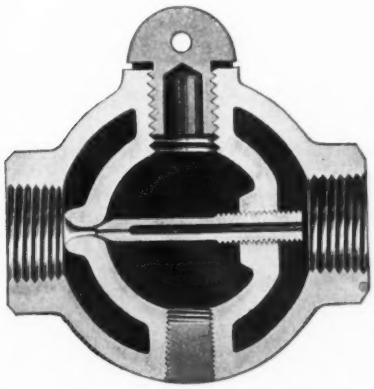
sible to form a finer and thicker network than in the oil which has not been heated.

Numerous tests have been devised to determine the pour test of lubricating oils each of which gives various and sundry results in the hands of different operators, due not only to ambiguity and lack of conciseness of the description of apparatus and method but also in the application of the methods to oils for which they are adaptable.

Committee D-2 of the American Society for Testing Materials have taken considerable pains to work out a standard method for this determination. This method, while not new in principle, is more complete in detail than any previously published. It includes a precise definition of "cloud test" and "pour test" and classifies the oils in which each or both are applicable. Attention is therefore called to the report of this committee in event of the desire to study this matter of pour test in greater detail.

## The Viscosity

The fact that pneumatic tool lubricants must frequently function under varying temperature conditions, and at varying speeds dependent upon the service and whether or not valves are involved, renders viscosity also a matter of im-



*Courtesy of Chicago Pneumatic Tool Co.*

Fig. 17—Sectional view of the "Little Giant" Automatic Oiler. Note the oil chamber in the center, and the needle or pin valve. Air passing through the latter carries the necessary amount of oil into the tool. This is an atomizer type of oiler.

portance. Air tools of the valveless type, for example: such as are extensively used in the stone cutting trade, will function best on a light viscosity oil of approximately 100 to 200 seconds Saybolt at 100 degrees Fahr. On the other hand certain types of hoists involving gear reductions will require products of approximately 115 seconds Saybolt viscosity at 210 degrees Fahr. In turn, rock drills, stopers, augers, etc., operating on dry air will function well on a medium viscosity oil, say in the neighborhood of 500 seconds at 100 degrees Fahr.

While the above stated viscosities will in general cover average conditions of pneumatic tool operation, it must be borne in mind that abnormal temperatures may frequently require a certain departure from these limits. For example, where such tools operated in extremely cold climates, 100 seconds Saybolt viscosity might even be too high to insure adequate

*Courtesy of The Denver Rock Drill Mfg. Co.*

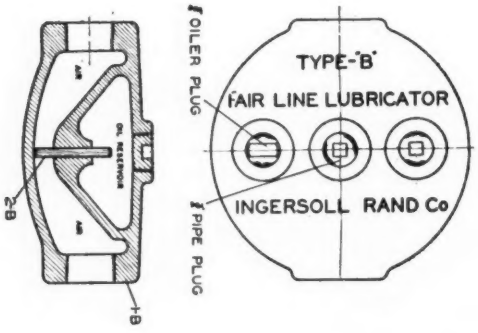
Fig. 18—The Waugh Line Oiler which is extensively used for the auxiliary lubrication of rock drills. This oiler can be attached to the air line close to the drill.

fluidity, it being advisable to select a naphthenic base oil of approximately 70 seconds viscosity for cylinder and valve lubrication. In contrast a tool operating under higher pressures and temperatures as in the mines or in the tropics would probably function most satisfactorily on a lubricant such as a medium viscosity motor oil of approximately 300 seconds Saybolt at 100 degrees Fahr.

For the information of those not fully conversant with this explanation of viscosity, it is well to state that viscosity is that inherent property by virtue of which the flow of liquids is retarded. It is therefore possessed by all oils, in varying degrees. In effect it is the resistance offered by the particles or molecules of a liquid in sliding past each other.

Viscosity is commonly measured by taking the time required for a certain quantity of the liquid in question to flow through an orifice of standard size under standard temperature conditions. The Saybolt universal viscosimeter has been adopted for this purpose by the American Society for Testing Materials. In the oil industry it constitutes the measurement of the number of seconds required for 60 cu. cm. of oil to flow through the orifice at the standard temperature. For lighter products such as engine and machine oil, this is usually 100 degrees Fahr. For heavier oils, such as gear compounds

and steam cylinder oils, 210 degrees Fahr. is commonly used. Therefore, when an oil is referred to as having a Saybolt viscosity of 100 seconds at 100 degrees Fahr., it implies that 100 seconds will be required for 60 cu. cm. to flow through the standard Saybolt viscosimeter at 100 degrees Fahr.




*Courtesy of Ingersoll-Rand Co.*

Fig. 19—Top and sectional view of another type of air line oiler.

## METHODS OF LUBRICATION

While the type and extent of refinement of the lubricants employed have much to do with efficient operation of pneumatic tools, the means whereby the former are admitted or distributed has a marked effect upon their ability to best serve the intended purpose. It is evident that even the best of oils or greases fail to do their best work if they are but haphazardly used, in such a manner as to be unable to reach all the wearing elements of the tools.

Tool builders will agree that perhaps more failures or complaints arise from ineffectual lubrication through misusage of lubricants than from any average operating condition. In many cases this will be due to ignorance; in others, however, sheer neglect is the reason often because of lack of appreciation of the lubricating requirements of their equipment.

There are a number of very excellent oils and greases on the market, in most cases refined more or less especially to serve pneumatic tools, with a minimum of fluid friction, a maximum of sealing ability in the prevention of air blow-by past the piston, excellent lubricating ability and a pour test commensurate with the operating requirements as already mentioned.

It is therefore up to the operator to use these products intelligently, in accordance with the recommendations of the builders of his tools, and the oil company from whom he purchases. Makeshift or obsolete ideas may have been permissible in the past; today, however, the necessity for maximum production demands the adoption of the most modern means of lubrication, in the interests of continued and efficient operation.

For this reason builders of pneumatic tools have given much attention to the development of automatic lubricators. Till today we have such excellent devices available as are shown in the accompanying illustrations. Such devices are installed either directly in the air line, a short distance back from the tool, or in some cases within the valve chest.

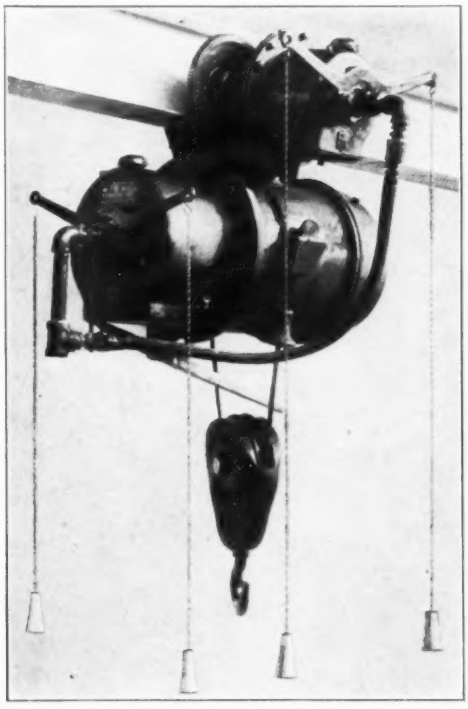
Air line lubricators are in general intended for the handling of fluid oils. As a rule they work on the principle of atomization, pulsation, or suction action. In the latter type the air in its passage through the working mechanisms, draws the requisite amount of oil from the reservoir by suction. Where atomization is involved, there is a needle or pin valve through which a certain amount of air passes to carry the required lubricant forward into the tool. In either case air as it passes through the lubricator becomes charged with oil in finely atomized condition, to insure effective distribution to all parts of the tool with which it may come in contact.

Pulsation is also employed in the lubrication of air prior to its passage to the tool. Operation of such a lubricator is brought about by the reciprocating action of the piston, oil being kept in continuous flow, thereby, to the air and tool mechanisms. Such a lubricator is frequently built with an oil capacity sufficient to last over a working shift. Therefore the possibility of lack of lubrication through negligence or carelessness on the part of drill or tool operators is reduced to a minimum.

*Courtesy of Hanna Engineering Works.*

Fig. 20—A suction type of oiler. Air in passing through exerts a suction action which charges it with sufficient oil to adequately lubricate all parts. Oil flows only when air is passing through the lubricator.

The valve chest lubricator operates by virtue of the pulsations of air in accordance with the movement of the tool piston within the cylinder. As a rule such a lubricator is designed for the usage of heavier oils or liquid greases. Relubrication or re-charging is brought about by



*Courtesy of Ingersoll-Rand Co.*

Fig. 21—An air motor hoist with motor driven trolley. To insure lubrication the motor is designed to operate in an oil bath, the gears in a semi-fluid grease. Piston pins, cylinders and cylinder bushings are drilled to effect lubrication of piston and crank pin.

the use of lubricant-carrying cartridges, through suitable plugs.

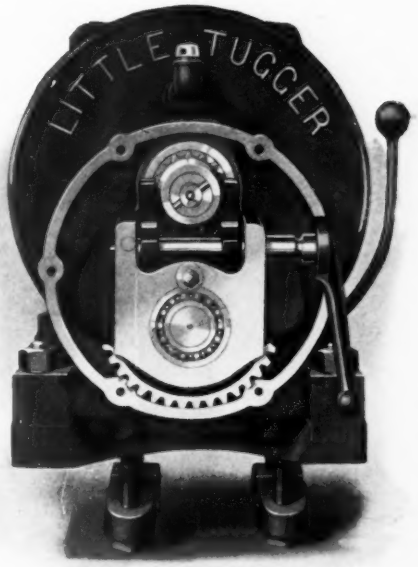
Chuck lubrication is also mechanically effected on many types of tools, a suitable device being attached near the front end adjacent to the chuck parts. In certain types of such lubricators ports are provided for carrying of the lubricant to the impact end of the piston and chuck mechanisms. Grease is usually preferred for the lubrication of such parts, a grade of medium bodied cup grease being adaptable to average operating conditions.

## CLEANLINESS AND METHODS OF CLEANING

The factor of cleanliness and the part which it plays in the ultimate continuance of efficient operation of pneumatic tools cannot be too strongly emphasized. We have already mentioned this in brief. It is now fitting to discuss those means of cleanliness which will most surely protect our pneumatic tools from abnormal wear, rust, corrosion and other deterioration.

Benzine, kerosene or gasoline are usually the most suitable cleaning mediums for air tools. Especially where greases are used will there be a tendency for accumulation of gummy, residual matter to occur. The entry of foreign matter will tend to increase this, as well as involving an abrasive element in the problem if it is allowed to become so extensive as to materially interfere with the motion of the tool mechanisms.

Smaller tools can be effectively freed of such accumulation by submergence in a bath of any one of these cleaning fluids for a few hours, and then thorough blowing out with air. Soaking in this manner will cut or dissolve any gummy matter accruing from the lubricant, and so loosen any solid foreign matter that it will be




*Courtesy of Ingersoll-Rand Co.*

Fig. 22—A "Little Tugger" hoist with gear cover removed, showing the gears and bearings. A built-in "heart-beat" lubricator is located in the cylinder head. The gear cover serves to form a reservoir for the lubricants for gear and clutch mechanisms.

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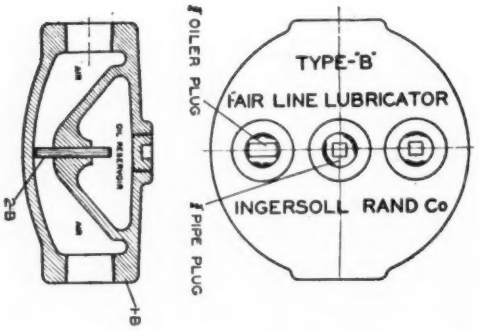


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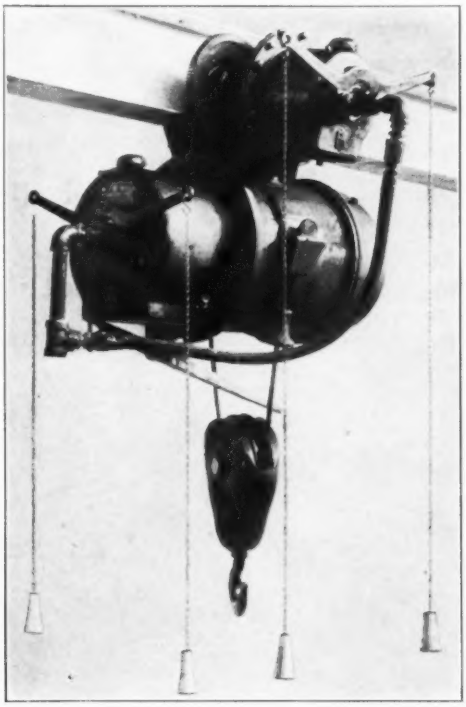

*Courtesy of Ingersoll-Rand Co.*

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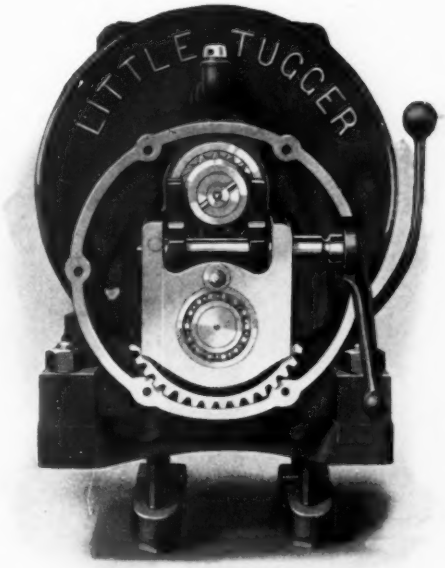
Smaller tools can be effectively freed of such accumulation by submergence in a bath of any one of these cleaning fluids for a few hours, and then thorough blowing out with air. Soaking in this manner will cut or dissolve any gummy matter accruing from the lubricant, and so loosen any solid foreign matter that it will be




*Courtesy of Ingersoll-Rand Co.*

Fig. 22—A "Little Tugger" hoist with gear cover removed, showing the gears and bearings. A built-in "heart-beat" lubricator is located in the cylinder head. The gear cover serves to form a reservoir for the lubricants for gear and clutch mechanisms.

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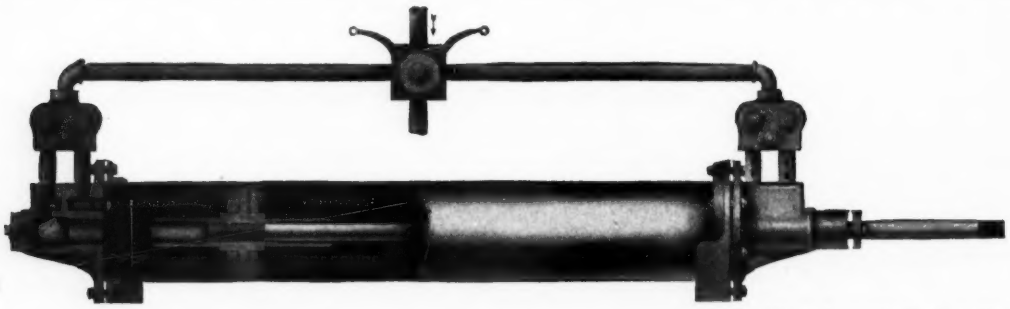
Large tools, however, may require disassembling to a more or less extent when cleaning is necessary, or if the tool has been laid up for any length of time. The parts should then

be soaked for a sufficient length of time to soften or cut any gummy matter and permit of easy washing off of such other foreign residuum which may not be soluble.

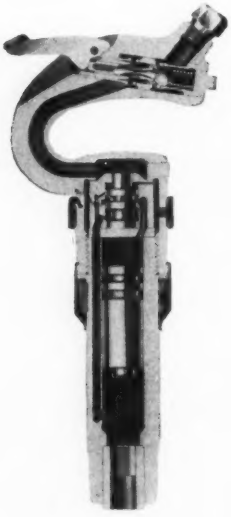
An effective way of preventing accumulations of foreign matter in pneumatic tools is to suspend them in a bath of cleaning fluid whenever they are not in use. We must remember that oxidation by virtue of contact with the air, especially if this latter is at all moist, is one of the chief reasons for the formation of rust, corrosive matter and gummy residues from certain classes of lubricants. Immersion, therefore, is an excellent preventive against oxidation.

Prior to re-usage any pneumatic tool should of course be thoroughly re-lubricated with fresh oil or grease according to its requirements.



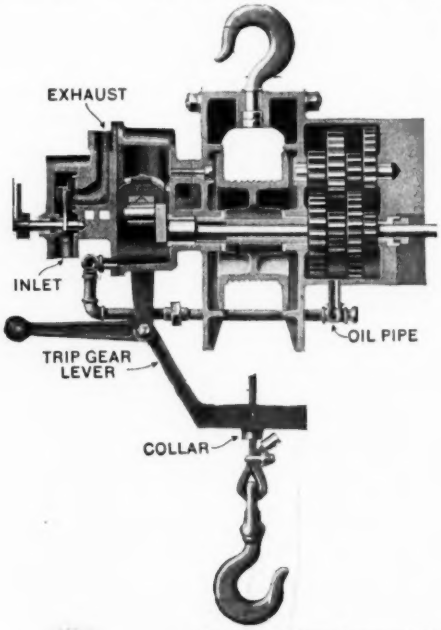
*Courtesy of Curtis Pneumatic Machinery Co.*

Fig. 23—A double acting air hoist showing cylinder construction and pneumatic cushions.



*Courtesy of King Pneumatic Tool Co.*

Fig. 24—Sectional view of a chipper showing main and throttle valve design and other details of construction. The sensitiveness of the throttle is claimed as a feature of this tool.




*Courtesy of Chicago Pneumatic Tool Co.*

Fig. 25—A "Little Giant" geared air hoist showing details of construction. Note the oil pipe in particular.

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